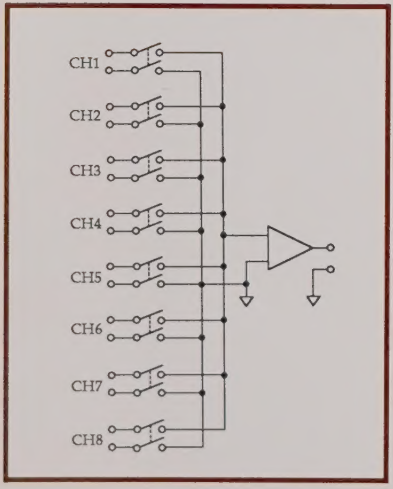
KEITHLEY

QUICK REFERENCE GUIDE



MODEL 199
SYSTEM DMM SCANNER

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INTRODUCTION

This quick reference guide contains information on front panel operation and IEEE-488 programming of the Model 199 System DMM as well as the optional Model 1992 Scanner. Also included are programming examples for various IEEE-488 controllers.

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SAFETY PRECAUTIONS

1. Before operation, ground the instrument through a properly earth grounded power receptacle.
2. Before servicing, disconnect the instrument from the power line and all other equipment, and consult the Model 199 Instruction Manual.
3. Do not touch any terminals while the instrument is turned on or connected to any other test equipment.
4. Do not exceed the maximum input levels as stated in the specifications for the instrument (see the Model 199 Instruction Manual).
5. Use the special precautions listed in paragraph 2.6 of the Model 199 Instruction Manual when testing high-energy circuits.

CONTROL SUMMARY

TRIG SETUP

SHIFT/TRIG SETUP to enter menu.

NEXT to scroll to next menu option.

Trigger ▲/▼
- CONTINUOUS: Reading, scanning, and storing rates controlled by INTERVAL.
- ONE SHOT.

DELAY — 0sec to 999.999sec

INTERVAL ▲/▼
- SELECT OFF: Interval ≥175msec, depending on other programmed parameters.
- SELECT ON: User-programmed interval (15msec to 999.999sec).

DMM SETUP

SHIFT/DMM SETUP to enter menu.

NEXT to scroll to next menu option.

REV — Displays current software revision level.

MUX ▲/▼
- MUX OFF: Turns off autocal routines for faster reading rates.
- MUX ON: Recommended for best accuracy.

IEEE — Use numeric keys to program IEEE-488 primary address (0-30).

FREQ ▲/▼
- FREQ=50HZ. Line frequency.
- FREQ=60HZ. Line frequency.

SAVE ▲/▼
- SAVE YES: Saves present configuration.
- SAVE NO

LEDS ▲/▼
- LEDS ON: Test front panel LEDs and annunciators.
- LEDS OFF

DEBUG ▲/▼
- DEBUG YES: Enter troubleshooting mode.
- DEBUG NO

RESET ▲/▼
- RESET YES: Returns unit to factory default configuration.
- RESET NO

SCAN SETUP

SHIFT/SCAN SETUP to enter menu.

NEXT to scroll to next menu option.

POLE ▲/▼
- 2 POLE
- 4 POLE

Mode ▲/▼
- MANUAL: Allows channel to be manually closed with SCANNER key.
- STEP: Increments one channel per interval or trigger.
- SCAN: Scans one set of channels per interval or trigger (minimum time between channels).

RATIO ▲/▼
- ON: Channels 2 through 8 referenced to channel 1.
- OFF

- Ratio operates only on a fixed range.
- Range changes will restart at channel 1.
- In MANUAL, at least one reading must be taken on channel 1 before attempting to display ratio on channels 2-8

DISPLAY MESSAGES

Message	Description
OVERFL	Overrange
NO RANGE	Pressing range button while in dB
NO FUNC	Invalid shifted function entry.
SHIFT	Shift mode in effect.
AC ONLY	Selecting dB with unit not in AC.
TRIGGER OVERRUN	Unit triggered before reading is done.
INTERVAL OVERRUN	Interval too short for present configuration.
UNCAL	EEPROM failure upon power up.
NO DATA	No data in data store when recalling.
NO SCANNER	Pressing SCANNER or SCAN SETUP with no scanner.
CAL LOCKED	Attempting calibration with calibration locked.
CHAN 4 MAX	Channel 4 limit (4-pole)
CHAN 8 MAX	Channel 8 limit (2-pole)
CONFLICT	Invalid state when calibrating.
NO REMOTE*	Unit not in remote when programming over bus.
IDDC*	Illegal device-dependent command.
IDDCO*	Illegal device-dependent command option.
BIG STRING*	String longer than 10 characters with D command.
TRANSERR*	Translator error.

*IEEE-488 bus programming only.

TRIGGERING

Continuous

1. Press SHIFT TRIG SETUP then uprange or downrange to select CONTINUOUS trigger mode.
2. Press NEXT and then program desired trigger delay (delay affects only first reading in continuous).
3. Press NEXT and then use uprange/downrange for SELECT OFF (175msec) or user-progammed (SELECT ON). Key in interval (15msec-999.999sec) if selected, then press NEXT.
4. Unit displays readings at programmed intervals. "INTERVAL OVERRUN" message indicates programmed interval is too short for present instrument configuration (with data store or scanner only).

One Shot

1. Press SHIFT TRIG SETUP then uprange or downrange to select ONE SHOT trigger mode.
2. Press NEXT, and then program desired trigger delay (delay affects each reading in one shot).
3. Press NEXT to return to normal display.
4. Press TRIGGER or apply pulse to TRIGGER INPUT to initiate reading. One trigger per reading is required in one shot.

DATA STORE

Continuous Data Storage

1. Program the continuous trigger mode and desired interval using TRIG SETUP.
2. Press SHIFT STORE to enter data store.
3. Program the number of readings to store (size) in the range of 1 to 500, or select a size of 000 for wrap-around data store operation.
4. Press NEXT to return to normal display.
5. Press TRIGGER to initiate data storage. RCL will blink when all readings have been stored.
6. Press any function button to turn off data store.

One-shot Data Storage

1. Program the one-shot trigger mode using TRIG SETUP.
2. Press SHIFT STORE to enter data store.
3. Program the number of readings (size) in the range of 1 to 500, or select a size of 000 for wrap-around storage.
4. Press NEXT to return to normal display.
5. Press TRIGGER to trigger reading and store it. One trigger per reading is required in the one-shot trigger mode.
6. RCL will flash when all readings have been stored.
7. Press a function key to cancel data storage.

Recalling Data

1. Press SHIFT RECALL to enter the recall mode. The unit will display the last stored reading number.
2. Press NEXT to display the reading.
3. Use uprange or downrange to scroll through readings. The scroll rate becomes more rapid after holding button in.
4. Press RECALL to display reading number, then press NEXT to return to reading.
5. Press NEXT to exit recall.

DMM SETUP

Press SHIFT DMM SETUP to access modes below. Use NEXT to scroll through setup menu.

REV—Briefly displays current software revision level.

MUX ON/OFF—Use uprange or downrange to select on/off. Operating unit in MUX OFF turns off autocal routines, which speeds up reading rate and minimizes noise spikes at input. Accuracy is reduced in MUX OFF.

IEEE—Use numeric keys to program IEEE-488 primary address (0-30). Use SAVE to permanently change address.

FREQ=50/60HZ—Use uprange or downrange to select operating frequency. Selected frequency must agree with power line frequency for optimum noise performance.

SAVE YES/NO—Select operating modes then SAVE YES to store present instrument configuration. Unit will assume the saved configuration upon power up, or after receiving IEEE-488 DCL or SDC commands.

LEDS ON/OFF—Use uprange or downrange then press NEXT to test front panel LEDS.

DEBUG ON/OFF—Use uprange or downrange then press NEXT to enter diagnostic program. Press any key except TRIGGER to exit program.

RESET YES/NO—Select RESET YES with uprange or downrange to return the unit to factory default conditions. Use SAVE after RESET to restore power up default to factory default conditions.

SCANNER OPERATION

Manual Channel Control

1. Press SHIFT SCAN SETUP, then program 2/4-pole mode with uprange or downrange.
2. Press NEXT, then select MANUAL mode with uprange or downrange.
3. Press NEXT, then select ratio on/off with uprange or downrange.
4. Press NEXT to return to normal display.
5. Press SCANNER followed by the number of the channel to close (1-8). The unit will display the closed channel number in the right-most digit.
6. Press SCANNER 0 to open any closed channel and return to normal operation.

Step Mode

1. Press SHIFT SCAN SETUP, and program 2/4 pole mode.
2. Press NEXT, then use uprange/downrange to select STEP mode.
3. Press NEXT, and select ratio on or off as desired.
4. Press NEXT to return to normal operation.
5. For interval scanning, use TRIG SETUP to select continuous trigger mode, delay, and to program the desired interval between channels.
6. For triggered scanning, use TRIG SETUP to select one-shot trigger mode and delay.
7. Press SCANNER, then program the desired channel limit (maximum limit = 4 for 4-pole mode).
8. If interval scanning was selected, the unit will begin scanning one channel per interval. The closed channel will appear in the display.

9. If triggered scanning was selected, press TRIGGER to start the scan. One trigger per channel will be required.
10. To exit the scan mode, press SCANNER 0.

Scan Mode

1. Press SHIFT SCAN SETUP, and program 2/4 pole mode.
2. Press NEXT, then use uprange/downrange to select SCAN mode.
3. Press NEXT, and select ratio on or off as desired.
4. Press NEXT to return to normal operation.
5. For interval scanning, use TRIG SETUP to select continuous trigger mode, delay, and to program the desired interval between sets of channels.
6. For triggered scanning, use TRIG SETUP to select one-shot trigger mode and delay.
7. Press SCANNER, then program the desired channel limit (maximum limit = 4 for 4-pole mode).
8. If interval scanning was selected, the unit will begin scanning one set of channels per interval. The closed channel will appear in the right-most digit of the display.
9. If triggered scanning was selected, press TRIGGER to start the scan. One trigger per set of channels will be required.
10. To exit the scan mode, press SCANNER 0.

Interval Data Store Scanning

1. Press SHIFT TRIG SETUP, and select CONTINUOUS trigger mode.
2. Press NEXT, and program desired trigger delay (0msec-999.999sec).

3. Press NEXT and choose SELECT OFF (default 175msec) or SELECT ON (user programmed interval, 15msec-999.999sec). For SELECT ON, key in desired interval, then press NEXT.
4. Press SHIFT SCAN SETUP, and select the 2/4 pole mode.
5. Press NEXT, and then use uprange or downrange to select the STEP or SCAN mode, as required.
6. Press NEXT, and program the ratio mode.
7. Press NEXT to return to normal display.
8. Press SHIFT STORE, then program the data store size.
9. Press NEXT to return to normal display.
10. Press Trigger to initiate scanning and storage on channel 1 simultaneously.

One-shot Trigger Data Store Scanning

1. Press SHIFT TRIG SETUP, and select ONE SHOT trigger mode.
2. Press NEXT, and program desired trigger delay (0msec-999.999sec).
3. Press NEXT to return to normal display.
4. Press SHIFT SCAN SETUP, and select the 2/4 pole mode.
5. Press NEXT, and then use uprange or downrange to select the STEP or SCAN mode, as required.
6. Press NEXT, and program the ratio mode.
7. Press NEXT to return to normal display.
8. Press SHIFT STORE, then program the data store size.
9. Press NEXT to return to normal display.
10. Press TRIGGER to initiate scanning and storage on channel 1 simultaneously. One trigger per channel is required in the STEP mode, and one trigger per set of channels is required in the SCAN mode.

Determining Scanning Interval

- Scanning without selecting interval
  - —Program INTERVAL SELECT to OFF.
  - —Interval is ≥175msec, depending on other selected parameters.
  - —INTERVAL OVERRUN message will not be displayed.
- Minimum Interval Time Calculation
  - —Interval time is the sum of:
    1. (conversions per channel) × (conversion time)
    2. Programmed DELAY time per channel
    3. Break-before-make time (17msec)
    4. Auto range time (if used)
  - —In STEP mode, calculated time above is the INTERVAL setting.
  - —In SCAN mode, (sum of 1-4) × (number channels scanned) is the minimum interval setting.

Scanner Operation Notes

- When using the scanner with STEP or SCAN switching, the DMM will take readings on each channel as if it were in the one-shot mode whether programmed to CONTINUOUS or ONE SHOT:
  - —Conversions are automatically synchronized to channel closures. Channels will not close in the middle of conversions.
  - —Any programmed DELAY is inserted between channel closure and start of conversion (with scanner disabled, DELAY is inserted between trigger and start of conversion).

—Readings on each channel consist of multiple conversions to fill the Running Average User Filter (30 conversions), or Running Average Internal Filter when active (5½d only, varies by range and function; see manual).

- Scanner switching is break-before-make. The time required to change channels is approximately 17msec, which includes break-before-make relay time settling time.
- When using the scanner with ACV or ACA, a DELAY time must be programmed to accomodate AC converter settling time (typically >1sec). See Model 199 specifications.
- The scanner operates with the set of instrument parameters programmed prior to start of scanning. Changing any of these parameters, range function, filter, etc., during scanning will restart the scanner at channel 1. Use autorange if range changes are required while scanning.

Example of Fast Scanning

1. Select 3V DC range and function, 4½-digit resolution, FLTR off.
2. Program ONE SHOT trigger.
3. Select SCAN mode.
4. Select SCANNER "8" to set limit to 8.
5. Use TRIGGER to initiate a scan of the set of eight channels.

TYPICAL READING TIMES

Typical 5½ Digit Conversion Times

MUX ON, DCV, ACV, ACA: 110msec (133msec)
MUX OFF: 28msec (33msec)

MUX ON, OHMS, 300kΩ range and lower: 110msec (133msec)
MUX OFF: 63msec (78msec)

(Times in parenthesis are for 50Hz operation)

Typical Autoranging Times

DCV, DCA	350msec
ACV, ACA	1.4sec
OHMS (300kΩ range and lower)	500msec

(Times shown are to correct range and do not include conversion times for final reading.)

DEVICE-DEPENDENT COMMANDS

Execute	
X	Execute other device-dependent commands.

Function	
F0	DC volts
F1	AC volts
F2	Ohms
F3	DC current
F4	AC current
F5	ACV dB
F6	ACA dB

Range				
	DCV	ACV	DCA	ACA
R0	Auto	Auto	Auto	Auto
R1	300mV	300mV	30mA	30mA
R2	3V	3V	3A	3A
R3	30V	30V	3A	3A
R4	300V	300V	3A	3A
R5	300V	300V	3A	3A
R6	300V	300V	3A	3A
R7	300V	300V	3A	3A

Range (Cont.)			
	Ohms	ACV dB	ACA dB
R0	Auto	Auto	Auto
R1	300Ω	Auto	Auto
R2	3kΩ	Auto	Auto
R3	30kΩ	Auto	Auto
R4	300kΩ	Auto	Auto
R5	3MΩ	Auto	Auto
R6	30MΩ	Auto	Auto
R7	300MΩ	Auto	Auto

Zero	
Z0	Zero disabled
Z1	Zero enabled
Z2	Zero enabled using a zero value (V)

Filter	
P0	Internal and front panel filter disabled
P1	Internal filter enabled
P2	Front panel filter enabled

Rate	
S0	4½-digit resolution, 2.59msec integration period
S1	5½-digit resolution, line cycle integration (16.67msec, 60Hz; 20msec, 50Hz)

Trigger Mode	
T0	Continuous on Talk
T1	One-shot on Talk
T2	Continuous on GET
T3	One-shot on GET
T4	Continuous on X
T5	One-shot on X
T6	Continuous on External Trigger
T7	One-shot on External Trigger

Reading Mode	
B0	Readings from A/D converter
B1	Individual readings from data store
B2	All readings from data store (buffer dump)

Data Store Size	
I0	Wrap around data store mode
In	Data store of n (n=1 to 500)

Interval	
Q0	Default interval, 175msec (SELECT OFF)
Qn	n=interval in milliseconds (15msec to 999999msec)

Value	
V±nn.nnnn or V±n.nnnnnnE+n	Calibration value, zero value

Calibration	
C0	Calibrate first point using value (V)
C1	Calibrate second point using value (V)
C2	Calibrate third point using value (V)

Default Conditions	
L0	Restore factory default conditions and save (L1)
L1	Save present machine states as default conditions

Data Format	
G0	Reading with prefix.
G1	Reading without prefix.
G2	Reading and buffer location with prefix.
G3	Reading and buffer location without prefix.
G4	Reading and channel with prefix.
G5	Reading and channel without prefix.
G6	Reading, buffer location, and channel with prefix
G7	Reading, buffer location, and channel without prefix

SRQ	
M0	Disable
M1	Reading overflow
M2	Data store full
M4	Data store half full
M8	Reading done
M16	Ready
M32	Error

EOI and Bus Hold-off	
K0	Enable EOI and bus hold-off on X
K1	Disable EOI, enable bus hold-off on X
K2	Enable EOI, disable bus hold-off on X
K3	Disable both EOI and bus hold-off on X

Terminator	
Y0	CR LF
Y1	LF CR
Y2	CR
Y3	LF

Status	
U0	Send machine status word
U1	Send error conditions
U2	Send Translator word list
U3	Send buffer size
U4	Send current value of "V"
U5	Send input switch status (front/rear)

Multiplex	
A0	Auto/Cal multiplex disabled
A1	Auto/Cal multiplex enabled

Delay	
Wn	n=delay period in milliseconds, (0msec to 999999msec)

Self-test	
J0	Test, ROM, RAM, E²PROM

Hit Button	
Hn	Hit front panel button number n

Display	
Da	Display up to 10 character message. a=character
D	Cancel display mode

SCANNER PROGRAMMING COMMANDS

Scanner Setup		
	MANUAL	
N0	All channels open	
	2-pole	4-pole
N1	1	1
N2	2	2
N3	3	3
N4	4	4
N5	5	CHAN 4 MAX ERROR
N6	6	CHAN 4 MAX ERROR
N7	7	CHAN 4 MAX ERROR
N8	8	CHAN 4 MAX ERROR
N9	CHAN 8 MAX ERROR	CHAN 4 MAX ERROR
	STEP	
N10	Stop scan, all channels open	
	2-Pole Limit	4-Pole Limit
N11	1	1
N12	2	2
N13	3	3
N14	4	4
N15	5	CHAN 4 MAX ERROR
N16	6	CHAN 4 MAX ERROR
N17	7	CHAN 4 MAX ERROR
N18	8	CHAN 4 MAX ERROR
N19	CHAN 8 MAX ERROR	CHAN 4 MAX ERROR
	SCAN	
N20	Stop scan, all channels open	
	2-Pole Limit	4-Pole LImit
N21	1	1
N22	2	2
N23	3	3

Scanner Setup (Cont.)		
N24	4	4
N25	5	CHAN 4 MAX ERROR
N26	6	CHAN 4 MAX ERROR
N27	7	CHAN 4 MAX ERROR
N28	8	CHAN 4 MAX ERROR

Pole/Ratio	
O0	2-pole
O1	4-pole
O2	2-pole ratio
O3	4-pole ratio

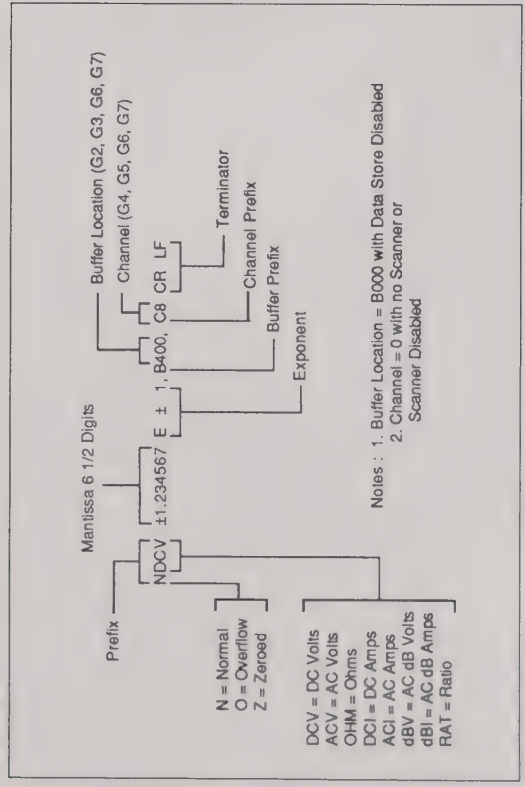
Scan Interval	
Q0	Default 175msec interval (SELECT OFF)
Qn	n=interval in msec (15≤999999msec)

Trigger Delay*	
Wn	n = delay in msec (0≤999999msec)

*Delay to be used as channel settling time

DATA FORMAT

Figure 1. Data Format

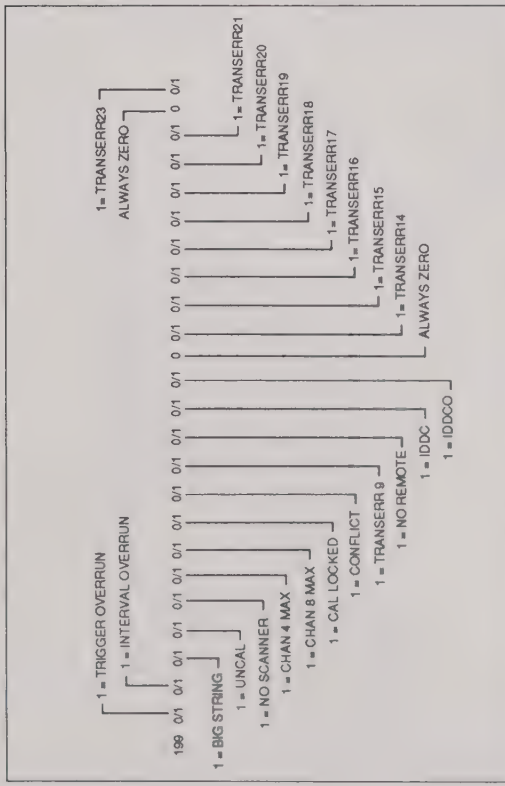

Prefix
Mantissa 6 1/2 Digits
NDCV ±1.234567 E ± 1, B400, C8 CR LF
Buffer Location (G2, G3, G6, G7)
Channel (G4, G5, G6, G7)
Terminator
Channel Prefix
Buffer Prefix
Exponent
N = Normal
O = Overflow
Z = Zeroed
DCV = DC Volts
ACV = AC Volts
OHM = Ohms
DCI = DC Amps
ACI = AC Amps
dBV = AC dB Volts
dBI = AC dB Amps
RAT = Ratio
Notes : 1. Buffer Location = B000 with Data Store Disabled
2. Channel = 0 with no Scanner or
Scanner Disabled

STATUS WORD FORMATS

Figure 2. U0 Status Word Format

Model Number
1 = Cal Enabled
199 A B F G J K M M N N O P Q Q Q Q R S T W W W W W Y Z X X
Default 199 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 4 1 6 0 0 0 0 0 0 0 0 X X
1 = Scanner Present
Notes:
1. Letters correspond to device-dependent commands.
2. Default values correspond to command options.

Figure 3. U1 Status Word Format

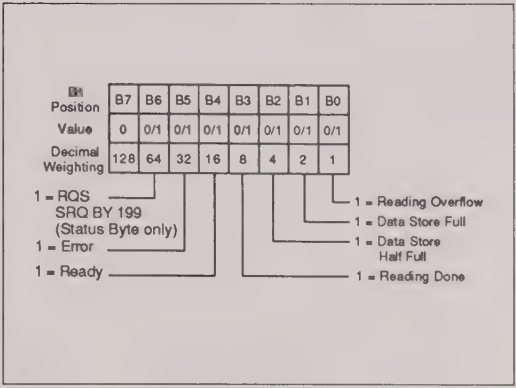

1 = TRANSERR23
ALWAYS ZERO
1 = TRIGGER OVERRUN
1 = INTERVAL OVERRUN
199 0/1 0/1 0/1 0/1 0/1 0/1 0/1 0/1 0/1 0/1 0/1 0/1 0/1 0/1 0/1 0/1 0/1 0/1 0/1 0/1 0/1 0 0/1
1 = TRANSERR21
1 = TRANSERR20
1 = TRANSERR19
1 = TRANSERR18
1 = TRANSERR17
1 = TRANSERR16
1 = TRANSERR15
1 = TRANSERR14
ALWAYS ZERO
1 = IDDCO
1 = IDDC
1 = NO REMOTE
1 = TRANSERR 9
1 = CONFLICT
1 = CAL LOCKED
1 = CHAN 8 MAX
1 = CHAN 4 MAX
1 = NO SCANNER
1 = UNCAL
1 = BIG STRING

U2-U5 Status Words

U2	Returns Translator word list.
U3	Returns data store size.
U4	Returns present value programmed with V command in floating point.
U5	Returns INPUT switch status (0= front, 1= rear).

SRQ MASK AND STATUS BYTE FORMAT

Figure 4. SRQ and Status Byte Format


Bit Position
B7 B6 B5 B4 B3 B2 B1 B0
Value
0 0/1 0/1 0/1 0/1 0/1 0/1 0/1
Decimal Weighting
128 64 32 16 8 4 2 1
1 = RQS SRQ BY 199 (Status Byte only)
1 = Error
1 = Ready
1 = Reading Overflow
1 = Data Store Full
1 = Data Store Half Full
1 = Reading Done

TRANSLATOR

Translator Words and Characters

Translator Word or Character	Description
ALIAS	Defines Translator words.
;	Terminates definition string.
$	Wildcard definition character.
NEW	Enables Translator.
OLD	Disables Translator.
SAVE	Saves Translator words as power-up default.
LIST	Returns list of Translator words.
FORGET	Purges Translator words from memory.

Translator Errors

Display Message	Description
TRANSERR 9	No more Translator memory left.
TRANSERR14	Use of more than one ALIAS in definition.
TRANSERR15	Translator word exceeds 31 characters.
TRANSERR16	Use of X in a Translator word.
TRANSERR17	Defined word already exits.
TRANSERR18	$ character used in definition.
TRANSERR19	; character sent by itself.
TRANSERR20	LIST used in definition.
TRANSERR21	FORGET used in definition.
TRANSERR23	SAVE used in definition.

CONTROLLER PROGRAMS

The following programs have been supplied as a simple aid to the user and are not intended to suit specific needs. Each program allows you to send a device-dependent command string to the instrument and obtain and display an instrument reading string.

IBM PC OR AT

(National Instruments GPIB-PC Interface)

The following program sends a command string from an IBM PC or AT computer and displays the instrument reading string on the computer CRT. The computer must be equipped with the National Instruments GPIB-PC IEEE-488 interface and the DOS 2.0 or 3.0 operating system. The GPIB-PC software must be installed and configured as described in the instruction manual.

DIRECTIONS

1. From the front panel, set the primary address of the Model 199 to 26.
2. With the power off, connect the Model 199 to the IEEE-488 interface installed in the IBM computer.
3. Type in BASICA on the computer keyboard to get into the IBM interpretive BASIC language.
4. Place the interface software disk in the default drive, type LOAD"DECL", and press the return key.
5. Add the lines below to the declaration file; also modify the address in lines 1 and 2, as described in the GPIB-PC instruction manual.
6. Run the program and type in the desired command string. For example, to place the instrument in the ACV function and autorange, type in F1R0X and press the return key.
7. The instrument reading string will then appear on the computer screen. A typical example is: NACV+0.000000E+0.

PROGRAM	COMMENTS
`10 CLS`	Clear screen
`20 NA$="GPIB0":CALL IBFIND(NA$,BRD0%)`	Find board descriptor.
`30 NA$="DEV1":CALL IBFIND(NA$,M199%)`	Find 199 descriptor.
`40 V%=26:CALL IBPAD(M199%,V%)`	Set primary address to 26.
`50 V%=1:CALL IBSRE(BRD0%,V%)`	Set REN true.
`60 INPUT"COMMAND STRING";C$`	Prompt for command string.
`65 C$=C$+CHR$(13)+CHR$(10)`	Add <CR> <LF> to command string.
`70 CALL IBWRT(M199%,C$)`	Send command string to 199.
`80 R$=SPACE$(25)`	Dimension reading input string.
`90 CALL IBRD(M199%,R$)`	Get reading string from 199.
`100 PRINT R$`	Display reading string on CRT.
`110 GOTO 60`	Repeat

NOTES:

1. For conversion to numeric variable, modify the program as follows:

```
100 R=VAL(MID$(R$,5,12))
105 PRINT R
```

2. In order for Translator to function properly, a <CR> <LF> sequence must be added to the end of any Translator execution string sent to the instrument. See line 65 above for an example.

IBM PC OR AT

CEC PC-488 Interface

The following program sends a command string from an IBM PC or AT computer and displays the instrument reading string on the computer CRT. The computer must be equipped with the Capitol Equipment Corp. PC-488 IEEE-488 interface. The interface card must be set to a memory address of $C400_H$, as described in the PC-488 Instruction Manual.

DIRECTIONS

1. From the front panel, set the primary address of the Model 199 to 26.
2. With the power off, connect the Model 199 to the IEEE-488 interface installed in the IBM computer.
3. Turn on the computer, then boot up BASICA.
4. Type in the program lines shown below, using the return key after each line.
5. Run the program and type in the desired command string at the command string prompt. For example, to place the instrument in the ACV function and autorange, type in F1R0X and press the return key.
6. The instrument reading string will then appear on the computer screen. A typical example is: NACV+0.000000E+0.

PROGRAM	COMMENTS
10 DEF SEG=&HC400	Set segment address to C400 hex.
20 INIT=0:SEND=9:ENTER=21	Define call offsets.
30 MY.ADDRESS%=21:CONTROLLER%=0	Define interface parameters.
40 ADDRESS%=26	Set 199 address to 26.
50 CALL INIT(MY.ADDRESS%,CONTROLLER%)	Initialize PC-488.
60 INPUT"COMMAND STRING";C$	Prompt for command string.
65 C$=C$+CHR$(13)	Add <CR> to string.
70 CALL SEND(ADDRESS%,C$,STATUS%)	Send command string to 199.
80 R$=SPACE$(25)	Dimension reading input string.
90 CALL ENTER(R$,LENGTH%,ADDRESS%,STATUS%)	Get reading string from 199.
100 PRINT R$	Display reading string.
110 GOTO 60	Repeat.

NOTES:

1. To convert from a string to a numeric variable, modify the program as follows:

```
100 R=VAL(MID$(R$,5,12))
105 PRINT R
```

2. For use with a card memory address other than $C400_H$, modify the DEF SEG statement in line 10 accordingly. For example, with a card memory address of $C000_H$, line 10 should be modified as follows:

```
10 DEF SEG=&HC000
```

3. In order for Translator to function properly, a <CR> sequence should be added to the end of any string sent to the Model 199. See the example is line 65 above.

HP SERIES 200 and 300

The following program sends a command string to the Model 199 from a Hewlett-Packard Series 200 or 300 computer and displays the instrument reading string on the computer CRT. The computer must be equipped with the HPIB Interface and BASIC 2.0, 3.0, or 4.0.

DIRECTIONS

1. From the front panel, set the primary address of the Model 199 to 26.
2. With the power off, connect the Model 199 to the HPIB interface installed in the computer.
3. Enter the computer EDIT mode.
4. Enter the lines in the program below, using the ENTER key after each line.
5. Run the program, and type in the desired command string at the command prompt. For example, to place the instrument in ACV and autorange, type in F1R0X and press the ENTER key.
6. The instrument reading string will then appear on the CRT. A typical display is: NACV+0.000000E+0.

PROGRAM	COMMENTS
10 REMOTE 726	Place 199 in remote.
15 DIM A$[25], B$[25]	
20 INPUT''COMMAND STRING'',A$	Prompt for and input command.
30 OUTPUT 726; A$	Address 199 to listen, send string.
40 ENTER 726; B$	Address 199 to talk, input reading.
50 PRINT B$	Display reading string.
60 GOTO 20	Repeat.
70 END	

NOTE: For conversion to a numeric variable, change the program as follows:

```
40 ENTER 726;B
50 PRINT B
```

APPLE II

APPLE II IEEE-488 Interface

The following program sends a command string to the Model 199 from an Apple II computer and displays the instrument reading string on the computer CRT.

The computer must be equipped with the Apple II IEEE-488 Interface installed in slot 3.

DIRECTIONS

1. From the front panel, set the primary address of the Model 199 to 26.
2. With the power off, connect the Model 199 to the IEEE-488 interface installed in the Apple II computer.
3. Enter the lines in the program below, using the RETURN key after each line.
4. Run the program and type in the desired command string at the command prompt. For example, to place the instrument in ACV and autorange, type in F1R0X and press the return key.
5. The instrument reading string will then appear on the CRT. A typical display is: NACV+0.00000E+0.

PROGRAM	COMMENTS
10 Z$=CHR$(26)	Terminator.
20 INPUT''COMMAND STRING ?'';B$	Prompt for and enter command string.
30 PR#3	Set output to IEEE-488 bus.
40 IN#3	Define input from IEEE-488 bus.
50 PRINT''RA''	Enable remote.
60 PRINT''WT:'';Z$;B$	Address 199 to listen, send string.
70 PRINT''LF1''	Line feed on.
80 PRINT''RDZ'';Z$;: INPUT'' '';A$	Address 199 to talk, input data.
90 PRINT''UT''	Untalk the 199.
100 PR#0	Define output to CRT.
110 IN#0	Define input from keyboard.
120 PRINT A$	Display reading string.
130 GOTO 20	Repeat.

NOTES:

1. If conversion to numeric variable is required, make the following changes:

```
120 A=VAL(MID$(A$,5,12))
125 PRINT A
```

2. The Apple II terminates on commas in the data string. To avoid problems, program the Model 199 for the B0G0 or B0G1 data format to eliminate commas.

HP MODEL 85

The following program sends a command string to the Model 199 from an HP-85 computer and displays the instrument reading string on the computer CRT. The computer must be equipped with the HP82937 GPIB Interface and an I/O ROM.

DIRECTIONS

1. From the front panel, set the primary address of the Model 199 to 26.
2. With the power off, connect the Model 199 to the HP82937A GPIB interface installed in the HP-85 computer.
3. Enter the lines in the program below, using the END LINE key after each line.
4. Press the HP-85 RUN key and type in the desired command string at the command prompt. For example, to place the instrument in ACV and autorange, type in F1R0X and press the END LINE key.
5. The instrument reading string will then appear on the CRT. A typical display is: NACV+0.000000E+0.

PROGRAM	COMMENTS
10 DIM A$[25],B$[25]	Dimension strings.
20 REMOTE 726	Place 199 in remote.
30 DISP''COMMAND STRING'';	Prompt for command.
40 INPUT A$	Input command string.
50 OUTPUT 726; A$	Address 199 to listen, send string.
60 ENTER 726; B$	Address 199 to talk, input reading.
70 DISP B$	Display reading string.
80 GOTO 30	Repeat
90 END	

NOTE: For conversion to numeric variable, change line 70 as follows:

```
70 DISP VAL(B$[5])
```

HP MODEL 9825A

Use the following program to send a command string to the Model 199 from a Hewlett-Packard Model 9825A and display the instrument reading string on the computer printer. The computer must be equipped with the HP98034A HPIB Interface and a 9872A extended I/O ROM.

DIRECTIONS

1. From the front panel, set the primary address of the Model 199 to 26.
2. With the power off, connect the Model 199 to the 98034A HPIB interface installed in the 9825A.
3. Enter the lines in the program below, using the STORE key after each line. Line numbers are automatically assigned by the 9825A.
4. Press the 9825A RUN key and type in the desired command string at the command prompt. For example, to place the instrument in ACV and autorange, type in F1R0X and press the CONT key.
5. The instrument reading string will then appear on the computer print out. A typical display is: NACV+0.000000E+0.

PROGRAM	COMMENTS
0 dim A$[25],B$[25]	Dimension data strings.
1 dev''199'',726	Define 199 at address 26.
2 rem''199''	Place 199 in remote.
3 ent''COMMAND STRING'', B$	Prompt for command string.
4 wrt''199'',B$	Address 199 to listen, send string.
5 red''199'',A$	Address 199 to talk, input data.
6 prt A$	Print data string on printer.
7 gto 3	Repeat.

NOTE: For conversion to numeric variable, modify the program as follows:

```
6 prt val(A$[5])
```

DEC LSI 11

The following program sends a command string to the Model 199 from a DEC LSI 11 minicomputer and displays the instrument reading string on the DEC CRT terminal. The LSI 11 must be configured with 16K words of RAM and an IBV 11 IEEE-488 interface. The software must be configured with the IB software as well as FORTRAN and the RT 11 operating system.

DIRECTIONS

1. From the front panel program feature, set the primary address of the Model 199 to 26.
2. With the power off, connect the Model 199 to the IBV 11 IEEE-488 interface cable.
3. Enter the program below, using the editor under RT 11 and the name IEEE.FOR.
4. Compile using the FORTRAN compiler as follows: FORTRAN IEEE.
5. Link with the system and IB libraries as follows: LINK IEEE,IBLIB.
6. Type RUN IEEE and press the RETURN key.
7. The display will read "ENTER ADDRESS".
8. Type in 26 and press the RETURN key.
9. The display will read "TEST SETUP".
10. Type in the desired command string and press the RETURN key. For example, to program the instrument for ACV and autorange, type in F1R0X and press RETURN.
11. The instrument data string will appear on the computer display. A typical display is: NACV+0.000000E+0.

PROGRAM	COMMENTS
PROGRAM IEEE	
INTEGER*2 PRIADR	
LOGICAL*1 MSG(80),	
INPUT(80)	
DO 2 I = 1,10	
CALL IBSTER(I,0)	Turn off IB errors.
2 CONTINUE	
CALL IBSTER(15,5)	Allow 5 error 15's.
CALL IBTIMO(120)	Allow 1 second bus timeout.
CALL IBTERM(10)	Set line feed as terminator.
CALL IBREN	Turn on remote.
4 TYPE 5	
5 FORMAT (1X,'ENTER ADDRESS:',$) ACCEPT 0,PRIADR	Input primary address.
10 FORMAT (I2)	
12 TYPE 15	
15 FORMAT (1X,'TEST SETUP: ',$)	Prompt for command string.
CALL GETSTR (5,MSG,72)	Program instrument.
CALL IBSEOI (MSG,-1, PRIADR)	Address 199 to listen, send string.
18 I=IBRECV (INPUT,80, PRIADR)	Get data from instrument
INPUT (I+1) = 0	
CALL PUTSTR (7,INPUT,'0')	
CALL IBUNT	Untalk the 199.
GOTO 12	Repeat.
END	

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